

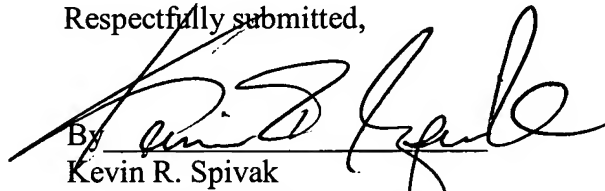
**REMARKS**

Amendments to the specification have been made and are submitted herewith in the attached Substitute Specification. A clean copy of the specification and a marked-up version showing the changes made are attached herewith. The claims and abstract have been amended in the attached Preliminary Amendment. All amendments have been made to place the application in proper U.S. format and to conform with proper grammatical and idiomatic English. None of the amendments herein are made for reasons related to patentability. No new matter has been added.

In the event the U.S. Patent and Trademark Office determines that an extension and/or other relief is required, applicant petitions for any required relief including extensions of time and authorizes the Commissioner to charge the cost of such petitions and/or other fees due in connection with the filing of this document to Deposit Account No. 03-1952 referencing docket no. **449122075500**. However, the Commissioner is not authorized to charge the cost of the issue fee to the Deposit Account.

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Respectfully submitted,



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**SUBSTITUTE SPECIFICATION  
(MARKED COPY)**

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PCT/DE03/00070

Description

**ELECTRICAL SWITCHING ARRANGEMENT HAVING AN  
ELECTROMAGNETIC RELAY AND A SWITCHING DEVICE WHICH IS  
5    ~~ARRANGED PARALLEL TO ONE CONTACT OF THE ELECTROMAGNETIC~~  
RELAY**

CLAIM FOR PRIORITY

10    This application is a national stage of International  
Application No. PCT/DE03/00070 which was published on  
July 31, 2003 and which claims the benefit of priority  
to German Application No. 102 03 682.9 filed January  
24, 2002.

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TECHNICAL FIELD OF THE INVENTION

The invention relates to an electrical switching  
arrangement having an electromagnetic relay, a  
switching device, whose outputs are arranged parallel  
20    to one contact of the electromagnetic relay, and a  
control arrangement which is connected to the coil of  
the electromagnetic relay and to the switching device.

BACKGROUND OF THE INVENTION

25    Such an arrangement is disclosed as a so-called  
instantaneous release unit in the appliance manual  
"Schutztechnik - Digitaler Oberleitungsschutz  
7SA518/519 V3.2" [Protective relaying - digital  
overhead line protection 7SA518/519 V3.2] issued by  
30    Siemens AG, November 1999 (cf. pp. 3-6, R-13 and R-15).  
This instantaneous release unit serves the purpose of  
reducing the switch-on time of a downstream protective  
device. For this purpose, the outputs of a switching  
arrangement are arranged parallel to one contact of an  
35    electromagnetic command relay. Both the switching  
arrangement and the command relay are connected to a  
control unit via isolated connecting lines. If the  
control arrangement emits a switching command, both the

contact of the electromagnetic relay and the output of the switching arrangement are short-circuited. The switching arrangement is designed such that its switch-on time is markedly shorter than that of the electromagnetic relay, with the result that the switch-on time of the switching arrangement and not that of the electromagnetic relay defines the switch-on time of the downstream protective device.

10                                    SUMMARY OF THE INVENTION

The invention ~~is based on the object of, on the one hand, improving~~ improves upon the above-described switching arrangement in terms of its lack of sensitivity with respect to electromagnetic interference and, on the other hand, markedly reducing the load on the relay contact owing to arc flashovers.

~~This object is achieved according to the invention by~~ In one embodiment of the invention, there is a voltage detection device being arranged between the control arrangement and the coil of the electromagnetic relay, ~~said the~~ voltage detection device instructing, in the event of a switch-on command being emitted by the control arrangement, a downstream drive unit to emit a switching signal which short-circuits the switching device on the output side, maintaining, when the switch-on command is ended, the switching signal until the contact of the electromagnetic relay is opened, and instructing, in the event of there being no switch-on command, the drive unit to emit a second switching signal which opens the switching device on the output side. By this means it is possible both to ensure a rapid switch-on time of downstream devices and to protect the contact of the relay by the electrical power being drawn completely by the switching device when the relay contact is opened. In addition, the arrangement according to the invention reliably

prevents the outputs of the switching arrangement from being inadvertently short-circuited owing to external interference and thus prevents downstream devices from being driven in an undesired manner when there is no  
5 switch-on command for the relay.

One advantageous ~~refinement~~ embodiment of the arrangement according to the invention ~~consists in~~ is the voltage detection device having a rectifier circuit  
10 which is connected on the input side to the control arrangement and the coil of the electromagnetic relay and is connected on the output side to the drive unit via a comparator. In this case, both in the event of a switch-on command from the control arrangement being  
15 present and in the event of a voltage being produced by induction in the coil of the electromagnetic relay during the switch-off procedure, the downstream comparator receives, via the rectifier circuit, a clear signal which instructs the comparator to drive the  
20 downstream drive unit such that it short-circuits the switching device at the beginning of a switch-on command and maintains the short-circuited state of the switching device for a specific period of time when the switch-on command is ended.

25 A voltage is advantageously continuously applied to one input of the comparator. When selecting a voltage such that it has the opposite polarity to the voltage emitted to the comparator by the rectifier circuit, it  
30 is possible to achieve the situation in which the comparator emits a clear signal to the downstream drive unit which instructs said drive unit to open the switching device.

35 In one advantageous ~~refinement~~ embodiment of the arrangement according to the invention, the drive unit has two signal conversion elements driven in phase

opposition in such a way that in each case one signal conversion element is active and one signal conversion element is inactive.

5 This means that it is easily possible, in the case of a first signal emitted by the comparator, for the drive unit to be instructed to close the switching device, and, in the case of a second signal emitted by the comparator having the opposite mathematical sign to the  
10 first signal, for the drive unit to be instructed to open the switching device. Depending on the mathematical sign of the signal emitted by the comparator, either one or the other signal conversion element is driven in this embodiment.

15 A further advantageous embodiment of the arrangement according to the invention provides for the outputs of the respectively inactive signal conversion element to be short-circuited via the respectively active signal  
20 conversion element. The respective short-circuiting of the signal conversion element which at that time is not emitting a signal further reduces the susceptibility of the arrangement to electromagnetic interference.

25 The signal conversion elements may advantageously be in the form of voltage transformers.

Alternatively, the signal conversion elements may advantageously be in the form of photovoltaic  
30 generators.

The switching device advantageously has at least one MOS transistor. This makes it possible to provide the required switching power at a low drive power after a  
35 relatively short switch-on time.

A further advantageous embodiment of the switching arrangement according to the invention provides for the switching device to operate bi-directionally. This makes it possible for both direct currents and  
5 alternating currents to be connected to the output of the switching arrangement.

#### BRIEF DESCRIPTION OF THE DRAWINGS

The invention is described in more detail below with  
10 reference to the drawing which illustrates one~~one~~ exemplary embodiment of the arrangement according to the invention ~~is illustrated in the figure in the form of a block circuit diagram for the purpose of explaining the invention.~~, in which:

15 Figure 1 shows a block circuit diagram according to an embodiment of invention.

#### DETAILED DESCRIPTION OF THE INVENTION

20 Figure 1 illustrates aA switching arrangement 1 has a control arrangement 2 which is used to switch on a device (not illustrated in the figure) which is connected to outputs 3 of the switching arrangement 1. The outputs 3 of the switching arrangement 1 are  
25 arranged parallel to one contact 4a of an electromagnetic relay 4 and to the output of a switching device 5. The coil 4b of the electromagnetic relay 4 is connected directly to the control arrangement 2. A voltage detection device 6, whose  
30 output is connected to the switching device 5 via a drive unit 7, is located between the control arrangement 2 and the electromagnetic relay 4.

The arrangement functions as follows: If a switch-on  
35 command is emitted by the control arrangement 2, the coil 4b of the electromagnetic relay 4 is excited and closes the contact 4a. Owing to the mechanical inertia

of the contact 4a, the electromagnetic relay 4 has a switch-on time which is usually greater than 5 ms. At the same time as the coil 4b of the electromagnetic relay 4, the voltage detection device 6 receives the switch-on command from the control arrangement 2. The voltage detection device 6 passes an actuating signal B on to the drive unit 7 in which a first switching signal S1 is generated, as a result of which the outputs A1 and A2 of the switching device 5 are short-circuited. Since the switching device 5 generally comprises electronic components, it has a markedly shorter switch-on time than the electromagnetic relay 4. When the switch-on command is emitted by the control arrangement 2, first of all the switching device 5 thus short-circuits its outputs A1 and A2 and draws the full power for driving the device connected to the outputs 3. As soon as the contact 4a of the relay 4 is closed, a significant proportion of the power may be passed through the closed contact 4a.

When the switch-on command emitted by the control arrangement 2 is ended, the magnetic field in the coil 4b of the electromagnetic relay 4 is dissipated. As a result, a back-e.m.f. is induced at the inputs of the coil 4b and is detected by the voltage detection device 6. The induced voltage is applied until the magnetic field in the coil 11 has completely dissipated and the contact 4a of the electromagnetic relay 4 is thus opened. As long as the induced voltage is applied, by means of the voltage detection device 6 the actuating signal B at the drive unit 7 and thus the switching signal S1 for short-circuiting the outputs A1 and A2 of the switching device 5 are maintained. As the contact opens, an arc is prevented from forming at the contact 4a of the electromagnetic relay 4 by the fact that the current can continue to flow via the closed output of the switching device 5. ~~Only~~ When the magnetic field

has dissipated and the contact 4a of the electromagnetic relay 4 is completely open does the switching device 5 also reverse the short circuit at its outputs A1 and A2.

5

If the control arrangement 2 does not emit or maintain a switch-on command, a further switching signal S2 is emitted by the voltage detection device 6 via the drive unit 7 to the switching device 5 for the purpose of opening the outputs A1 and A2 of the switching device 5 or for the purpose of keeping them open. This prevents the switching device 5 from being inadvertently switched on owing to electromagnetic interference.

15 The ways in which the voltage detection device 6, the drive unit 7 and the switching device 5 function will be explained in more detail below with reference to the figure. The voltage detection device 6 ~~contains~~ includes a rectifier circuit 13 and a comparator 14.

20 Both in the event of a switch-on command and in the event of an induced voltage being present, the rectifier circuit 13 provides a positive voltage across the comparator module 14 which thereupon likewise emits a so-called "high" signal, i.e. a positive back-e.m.f. at its output A3. If neither a switch-on command nor an induced voltage are present, a negative voltage takes effect at a further terminal 15 of the comparator 14; the comparator 14 thus emits a negative voltage at its output A3. The negative voltage at the terminal 15 is in this case of such a value that it is smaller than the positive voltage emitted by the rectifier circuit in the event of a switch-on command from the control arrangement 2.

35 Two signal conversion elements 16 and 17, which are connected precisely in phase opposition with the aid of an inverter 18 to the output A3 of the comparator 14,



are located in the drive unit 7. In the figure, the signal conversion elements 16 and 17 are illustrated as photovoltaic generators. If the comparator 14 provides a high signal, a voltage is generated at the output of the signal conversion element 16. By means of the inverter 18, the signal conversion element 17 receives a "low" signal, i.e. no voltage at its input, and thus does not produce an output voltage. If the comparator 14 emits a low signal at its output, the behavior of the signal conversion elements 16 and 17 is precisely reversed: The signal conversion element 16 does not emit an output voltage, whereas a voltage is applied to the output of the signal conversion element 17. The drive unit 7 also contains transistors 20 and 21, by means of which in each case the outputs of the signal conversion element (16, 17) which does not emit a voltage at its output can be short-circuited. This further reduces the susceptibility to electromagnetic interference.

The switching device 5 may (as illustrated in the figure) have two power MOS transistors 22 and 23 which are connected to one another at their source terminals, whereas the two drain terminals of the power transistors 22 and 23 form the outputs A1 and A2 of the switching device 5. The gate terminals of the power transistors 22 and 23 are connected to one another and to the positive output of the signal conversion element 16, whereas the two source terminals are connected to the positive output of the signal conversion element 17. If the signal conversion element 16 now produces a voltage at its output (this is the case when a high signal is emitted by the comparator 14), a positive voltage is applied at the gate terminals of the power transistors 22 and 23 and the transistors 22 and 23 are turned on. A current can thus flow via the outputs 3 of the switching arrangement 1. If the signal conversion

element 17 produces an output voltage (this is the case when a low signal is emitted by the comparator 14), a positive voltage with respect to the gate terminal is applied to the source terminals of the power transistors 22 and 23, and the power transistors block the current flow.

As an alternative to this, it is also possible for the power transistors 22, 23 to be turned off by the source/gate terminals of the power transistors 22, 23 being short-circuited. For this purpose, the connection between the positive output of the signal conversion element 17 and the source terminals of the power transistors 22, 23 between the points P1 and P2 needs to be removed and, in its place, the source terminals of the power transistors 22, 23 at point P2 need to be connected to the source terminal of the transistor 20 at point P3.

~~Patent Claims~~ What is claimed is: